(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
8 November 2001 (08.11.2001)

PCT

(10) International Publication Number
WO 01/84558 A1

(51) International Patent Classification[7]: G21F 3/00

(21) International Application Number: PCT/SE01/00935

(22) International Filing Date: 30 April 2001 (30.04.2001)

(25) Filing Language: Swedish

(26) Publication Language: English

(30) Priority Data:
0001583-4 2 May 2000 (02.05.2000) SE

(71) Applicant *(for all designated States except US)*: **BORN-TECH** [SE/SE]; Box 102, S-247 23 Södra Sandby (SE).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **BORNVALL, Ove** [SE/SE]; Box 102, S-247 23 Södra Sandby (SE).

(74) Agent: **AWAPATENT AB**; Box 5117, S-200 71 Malmö (SE).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

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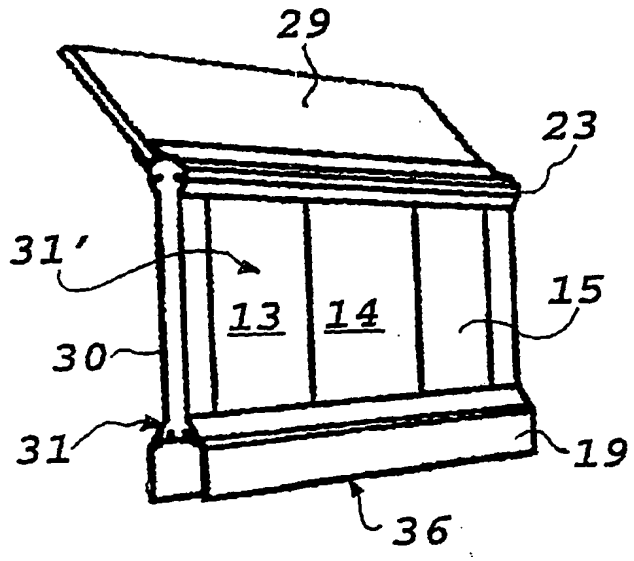
(54) Title: METHOD AND DEVICE FOR PROTECTION AGAINST RADIATION WHEN WORKING IN A RADIATING ZONE



(57) Abstract: A shield against radiation when working in a radiant zone comprises a screen (31') of a radiation-protective material. The screen (31') comprises at least two essentially vertically arranged sheets (13, 14, 15), which are relatively displaceable in the lateral direction along an essentially common plane, in such manner that they can form an opening of an adjustable width, through which opening work can be carried out in the radiant zone.

WO 01/84558 A1

METHOD AND DEVICE FOR PROTECTION AGAINST RADIATION WHEN WORKING IN A RADIATING ZONE

Field of the Invention

The present invention relates to a radiation shield when working in a radiant zone, said shield comprising a screen of a radiation-protective material.

The invention also relates to a method of protecting an operator against radiation by means of the shield.

Background Art

Radiation is used to an increasing extent in various processes, for instance such processes as are carried out in medical establishments. Examples of such radiation are X-ray radiation, radioactive radiation and laser radiation.

One example of a more and more frequently used method of treatment is X-ray examination of a patient where an operator is present during the actual radiation. Operator relates throughout this specification to all occupational categories which can be exposed to radiation when working, such as X-ray physician, X-ray nurse, radiologist, X-ray assistant and medical technician. The operator can see the X-ray pictures directly on a TV screen. For various reasons, the operator may want to handle the patient during examination. For instance, it is becoming more and more common for operations to be carried out by the operator during simultaneous X-ray radiation. The operator then operates on the patient based on the live X-ray pictures on the TV screen. One drawback is that the operator must stand close to the patient for a long time to be able to perform the operation using his hands, which causes the operator to be exposed to a great radiation dose. The radiation dose originates to a great extent from X-ray radiation which is reflected in all directions from the patient and

retroreflects on the operator. The most exposed parts of the operator are his thighs, trunk, chest and head.

US 4,965,456 discloses a radiation shield which is mounted on a rollable stand. The operator stands behind the radiation shield and moves the entire rollable stand when he wants to change position.

US 4,280,056 discloses a radiation shield which is movable along a treatment table. The operator can also insert his hands into a narrow gap under the actual shield.

Both shields mentioned above suffer from the drawback that they are unwieldy for the operator to move along to the correct position and that they only protect against radiation coming straight from the front. It is also difficult for the operator to find a good working position and to reach well with his arms.

Summary of the Invention

The object of the present invention is to provide a radiation shield, for instance for use in X-ray radiation with simultaneous treatment, which makes it possible for an operator to easily change position along a radiant zone, to be free to move his hands in the radiant zone and at the same time obtain good protection against radiation coming from the radiant zone both straight and obliquely from the front.

The invention also relates to a method of protecting an operator against radiation by means of a shield according to the invention.

According to the invention, this object is achieved by the device being given the features that are evident from claim 1. Preferred embodiments of the shield are defined in the dependent claims.

The object is also achieved by a method according to claim 11.

The inventive shield has a screen of a radiation-protective material. The screen has at least two essentially vertically arranged sheets, which are relatively

displaceable in the lateral direction along an essentially common plane, in such manner that an opening forms, through which opening work in the radiant zone can be carried out. The operator can thus easily on every occasion adjust the shield for maximum protection against radiation when working in the radiant zone, for instance when working using his one hand or both hands, working using various instruments, working in different positions in the radiant zone and in other work situations.

According to a preferred embodiment, the shield has a radiation-protective top which is fixed to the upper portion of the screen. The radiation-protective top protects the operator's chest, neck and face against radiation.

The radiation-protective top is preferably pivotable about an axis extending horizontally along the upper portion of the screen. This means that the radiation-protective top can be adjusted for maximum protection in the current work situation. It is also possible to temporarily turn away the radiation-protective top to be able to carry out certain operations in the radiant zone. It is a special advantage that, if parts of analysing equipment (e.g. a video recorder or camera for X-ray examinations) come into contact with the radiation-protective top, it will be possible to turn the top aside, thereby preventing damage to the analysing equipment.

The radiation-protective top is preferably made of a transparent material. This has the advantage that the operator can stand behind the shield and look down in the radiant zone through the radiation-protective top. Thus the operator can perform operations in the radiant zone, his hands inserted through the above-mentioned opening, and at the same time see through the radiation-protective top what he is doing.

It is particularly preferred to make the radiation-protective top of lead glass or lead acrylic. Both materials provide excellent protection against radiation.

Lead acrylic has the further advantage that it is not susceptible to shocks.

The sheets are suitably supported by a frame, which is provided with at least one horizontal groove. The sheets are laterally displaceable in said groove. The frame is attachable to bars of an examination table. The possibility of placing the frame on the examination table allows the sheets to be relatively low, which significantly reduces their weight and makes them easier to handle.

According to a preferred embodiment, the sheets are made of lead sheets coated with plastic. These sheets provide excellent protection against radiation even if they have a relatively small thickness. This results in the sheets not being bulky, which makes the entire screen compact. The coating with plastic makes the sheets hygienic and easy to clean. The sheets coated with plastic also have low friction and slide easily in the above-mentioned groove.

According to another preferred embodiment, the sheets are made of a transparent material. This has the advantage that the operator with maintained protection can look into the radiant zone also from the side. Especially suitable materials are the above-mentioned materials lead acrylic and lead glass.

According to a further preferred embodiment, the sheets are made of a flexible material, for instance lead vinyl or lead rubber, which protects against radiation. This has the advantage that the operator can insert his hand between two neighbouring sheets while exerting a small pressure, thus forming an opening. Since the sheets are flexible, they will shut tightly round the operator's hand and give good protection against radiation. When the operator removes his hand through the opening, the sheets will, by being flexible, close the opening.

Brief Description of the Drawings

The invention will now be described in more detail with reference to the accompanying drawings which by way of example illustrate preferred embodiments of the invention.

Fig. 1 is an overall view and shows two operators at an X-ray table which is provided with a shield according to the invention.

Fig. 2 is a side view in cross-section and shows a shield according to the invention.

Fig. 3 is a top plan view in cross-section and shows a shield in three different positions.

Fig. 4 is a perspective view and shows a preferred embodiment of the invention.

Fig. 5 is a perspective view and shows another preferred embodiment of the invention.

Description of Preferred Embodiments

Fig. 1 shows two shields 1 which are slidingly mounted on an X-ray table 2. The shield 1 protects two operators, one radiologist 3 and one assistant 4, against X-ray radiation reflected from a patient 5. Above the patient 5 a picture recorder 6 is located, which is placed between the shields 1, for recording X-ray pictures.

The operators 3, 4 insert their hands 7 through openings 8 in the shield 1 and can thus work with the patient 5. Along the sides of the X-ray table 2, radiation-protective curtains 9 of lead rubber are suspended, which protect the operators' 3, 4 legs and thighs. The X-ray table 2 is vertically adjustable by means of a telescopic support 10.

Along the sides of the X-ray table 2, also two bars 11 extend which support the shields 1 and the radiation-protective curtains 9. The shields 1 thus shield an X-ray radiant zone 12 from the area where the operators 3, 4 are positioned.

As is evident from Fig. 2, the shield 1 has three parallel sheets 13, 14, 15. The sheets 13, 14, 15 are made of lead lamellae coated with plastic and can at their lower edges slide in grooves 16, 17, 18 which are formed in a first aluminium section 19. At their upper edges the sheets 13, 14, 15 can slide in grooves 20, 21, 22 which are formed in a second aluminium section 23. The first section 19 has a lower recess 24 in which the bar 11 fits. The recess 24 is internally provided with nylon rulers for the shield 1 to be fitted with low friction on the bar 11.

In the upper portion 26 of the second section 23, a specially formed opening 27 is arranged. The opening 27 is formed in such manner that a holder section 28 of aluminium can be snapped into the same to a horizontally pivotable, hinge-like position. A radiation-protective top 29 is fixed to the upper portion of the holder section 28. The radiation-protective top 29 is made of lead glass and can, as shown by an arrow in Fig. 2, be pivoted between an angled position where it is inclined over the X-ray radiant zone 12, and a vertical position. When the radiation-protective top 29 is angled towards the X-ray radiant zone 12, it affords a better general view of the patient 5 and better protection against radiation than in the case where it is vertically oriented.

The first section 19 and the second section 23 are held together by two vertical end sections 30 and 30'. The sections 19, 23, 30, 30' thus constitute a frame 31. The sheets 13, 14, 15 form the actual screen 31'.

Fig. 3 shows three basic positions A, B, C for the shield 1 (the operator 3 indicated in Fig. 3 is relevant only in connection with position B). Between these basic positions, the possibilities of adjustment are practically unlimited. The sheets 13, 13', 14, 14', 15, 15' have edge sections 32 at their vertical lateral edges. The edge sections 32 hook into each other, whereby the sheets 13, 14, 15 form a first sheet package 33 and the

sheets 13', 14', 15' form a second sheet package 34. Owing to the edge sections 32, the sheets 13, 14, 15 in a certain package 33 cannot slide apart but form a radiation-protective collapsible wall with more or less overlapping sheets 13, 14, 15.

In position A, which is a closed position, the sheets 13, 13', 14, 14', 15, 15' are maximally moved apart and form a closed radiation-protective wall.

In position B, the operator 3 has moved the packages 33, 34 together in the middle of the shield 1. The operator 3 puts his hands 7 through the openings 8 formed and can work in the X-ray radiant zone 12. The packages 33, 34 protect the operator's 3 chest 35 against X-ray radiation. Since the three sheets 13, 14, 15 and respectively 13', 14', 15' overlap each other, the radiation shield over the chest 35 will be three times thicker compared with the case where only one sheet 13, 13', 14, 14', 15, 15' protects the operator 3.

In position C, the packages 33, 34 have been moved maximally to the left and the right side, respectively, of the shield 1. In this position, large as well as small objects can be inserted into or taken out from the X-ray radiant zone 12 through the opening 8. It is of course also possible for the operator 3 to work in the opening 8, which in position C is large, which may be appropriate for special working operations.

Fig. 4 shows an element 36 which is made of a shield 1 according to the invention. According to the number of operators 3, 4, the length of the X-ray table 2 and the work to be done, one or more such elements 36 can be attached slidingly or fixedly to the bars 11 of the X-ray table 2. The number of sheets 13, 14, 15 in the element 36 is selected with regard to the length of the element 36 and the intended field of use.

Fig. 5 shows another embodiment of the invention. An element 37 has a plurality of sheets 38 which are made of flexible lead vinyl. The sheets 38 which form a screen

31' are so flexible that the operator 3, 4 can force his hand 7 between the sheets 38 and in this manner form an opening 8 between them. The flexible sheets 38 will shut relatively tightly round the operator's 3, 4 arms, which means that the leakage of radiation will be small. When the operator 3, 4 pulls out his hand 7, the sheets 38 will, by being flexible, once more close the opening 8.

It will be appreciated that a number of modifications of the above embodiments of the invention are feasible within the scope of the invention.

For instance, the opening 8 can be formed between two neighbouring sheets 13, 14, 15, 38. The opening 8 can also be formed between a sheet 13, 14, 15, 38 and an end section 30, 30'. An opening 8 can also be formed by the sheets 13, 14, 15, 38 being displaced from a previous, closed position, thereby forming an opening 8 in the position where the sheets 13, 14, 15, 38 were previously located.

The sheets 13, 14, 15, 38 can be made of a number of different radiation-protective materials. It is possible to use both opaque materials, such as lead, lead vinyl and lead rubber, and transparent materials, such as lead glass and lead acrylic. The sheets 13, 14, 15, 38 can either slide in grooves 16, 17, 18 or be provided with roll means or be flexible themselves.

The bars 11 can be fixedly or slidingly attached to the sides of the X-ray table 2. It is also possible to attach the shield 1 direct to the actual X-ray table 2. When the bars 11 are slidingly fixed to the X-ray table 2, the shield 1 can be moved along the X-ray table 2.

The use of extruded aluminium sections results in a low weight. The grooves 16, 17, 18 will also have low friction, thereby making the sheets 13, 14, 15 slide easily. Of course, it is also possible to use sections of other materials.

The radiation-protective top 29 can be made of a plurality of materials, both transparent, such as lead

glass and lead acrylic, and opaque, such as lead and lead rubber. The thickness of the radiation-protective top 29 (and thus radiation resistance counted in lead equivalents), length, width, attachment to the upper portion of the screen and angling possibilities can be selected for the current case to provide optimum accessability and protection against radiation. The shield 1 can also be provided with means for adjusting, either automatically or manually, the angle of the radiation-protective top 29, for instance in order to minimise irritating reflections.

The radiation-protective curtains 9 can be made in many different ways and of many different materials, such as lead, lead acrylic, lead rubber and lead vinyl. The radiation-protective curtains 9 can also be combined with the element 36, 37, whereby they accompany the element 36, 37 as it is being moved along the bar 11.

It is also possible to make high sheets 13, 14, 15, 38. In this case, the sheets 13, 14, 15, 38 roll, with the aid of roll means, direct on a floor, or the sheets 13, 14, 15, 38 slide in grooves 16, 17, 18 formed at the floor. The sheets 38 can also be flexible, in which case no grooves are necessary. The height of the sheets 13, 14, 15, 38 is adjusted so as to protect the operator's 3 legs, trunk and chest 35. It is also possible to make low sheets 13, 14, 15, 38 which slide or roll on the floor and only protect the lower part of the operator's 3 body.

In the above description, reference has been made to X-ray radiation. However, it is obvious to a person skilled in the art that the shield can also be used for other wavelengths than X-ray radiation, such as radioactive radiation, laser radiation and microwaves. Such an example is isotope treatment. In this treatment, an operator 3 prepares radioactive preparations which are used in different medical treatments and examinations. The preparating requires that the operator 3 can handle the preparations in a radioactively radiant zone with his

hands 7 while at the same time he is protected against the radioactive radiation. The material and thickness of the sheets 13, 14, 15 and, where appropriate, the radiation-protective top 29 are adjusted to give the desired protection against radiation.

CLAIMS

1. A radiation shield when working in a radiant zone (12), said shield comprising a screen (31') of a radiation-protective material, c h a r a c t e r i s e d in that the screen (31') comprises at least two essentially vertically arranged sheets (13, 14, 15, 38), which are relatively displaceable in the lateral direction along an essentially common plane, in such manner that they can form an opening (8) of an adjustable width, through which opening (8) work can be carried out in the radiant zone (12).

2. A shield as claimed in claim 1, c h a r a c - t e r i s e d in that a radiation-protective top (29) is fixed to the upper portion of the screen (31').

3. A shield as claimed in claim 2, c h a r a c - t e r i s e d in that the radiation-protective top (29) is pivotable about an axis extending horizontally along the upper portion of the screen (31').

4. A shield as claimed in claim 2 or 3, c h a r - a c t e r i s e d in that the radiation-protective top (29) is at least partly made of a transparent material.

5. A shield as claimed in any one of claims 2-4, c h a r a c t e r i s e d in that the radiation-protective top (29) is at least partly made of a material selected from the group comprising lead glass and lead acrylic.

6. A shield as claimed in any one of the preceding claims, c h a r a c t e r i s e d in that the sheets (13, 14, 15, 38) are supported by a frame (31), which is provided with at least one horizontal groove (16, 17, 18), that the sheets (13, 14, 15, 38) are laterally displaceable in said groove (16, 17, 18), and that the frame (31) is attachable to bars (11) of an examination table (2).

7. A shield as claimed in any one of the preceding claims, c h a r a c t e r i s e d in that the sheets (13, 14, 15) are at least partly made of lead sheets coated with plastic.

8. A shield as claimed in any one of claims 1-6, c h a r a c t e r i s e d in that the sheets (13, 14, 15, 38) are at least partly made of a transparent material.

9. A shield as claimed in claim 8, c h a r a c - t e r i s e d in that the sheets (13, 14, 15, 38) are at least partly made of a material selected from the group comprising lead glass and lead acrylic.

10. A shield as claimed in any one of claims 1-6, c h a r a c t e r i s e d in that the sheets (38) are at least partly made of a flexible radiation-protective material such as lead vinyl and lead rubber.

11. A method of protecting an operator (3, 4) against radiation when working in a radiant zone (12), c h a r a c t e r i s e d in that the operator (3, 4) using the screen (1) according to any one of the preceding claims displaces the sheets (13, 14, 15, 38) relative to each other in such manner that they form an opening (8), which is wide enough for the operator (3, 4) to work in the zone (12).

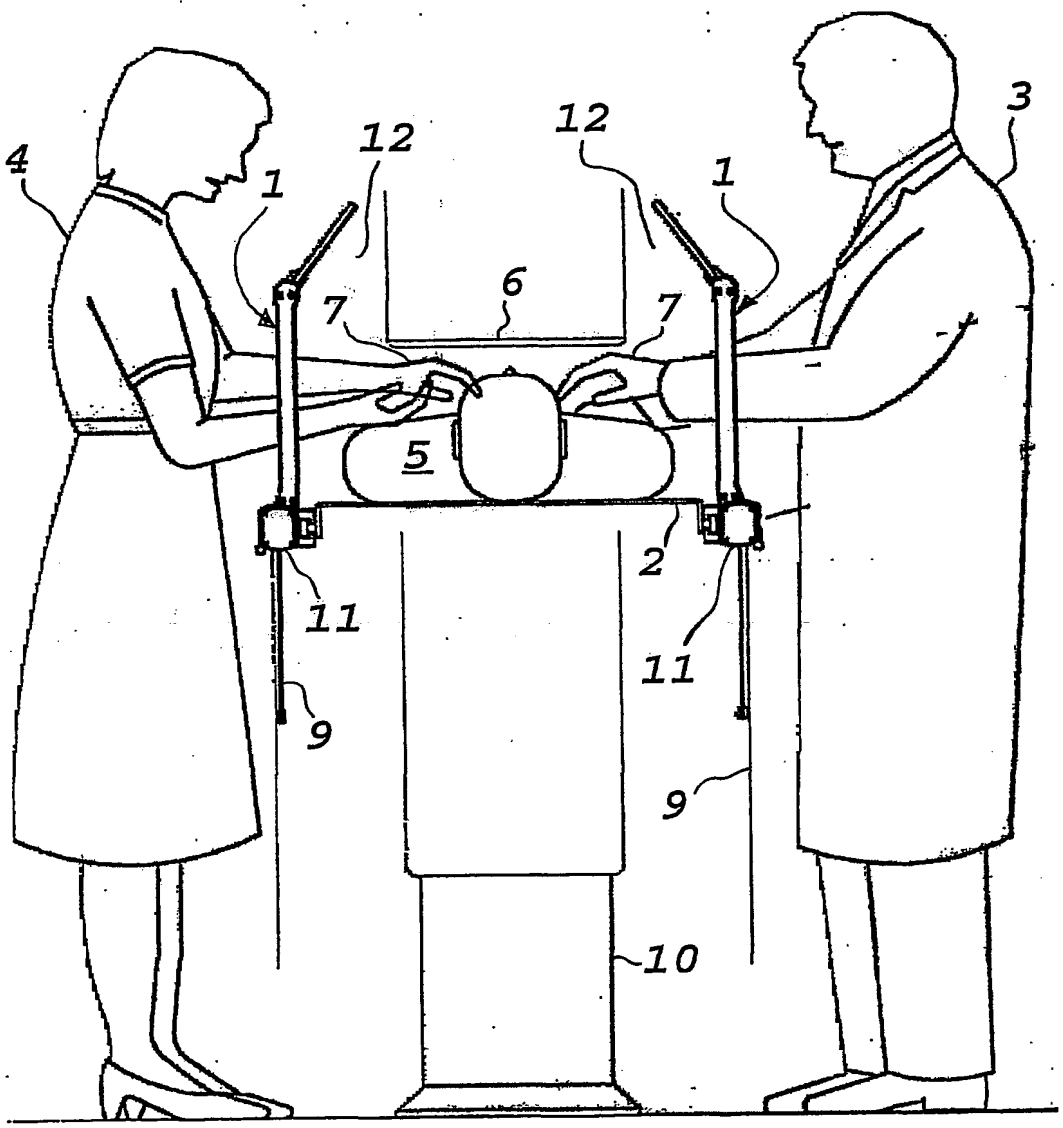


Fig 1

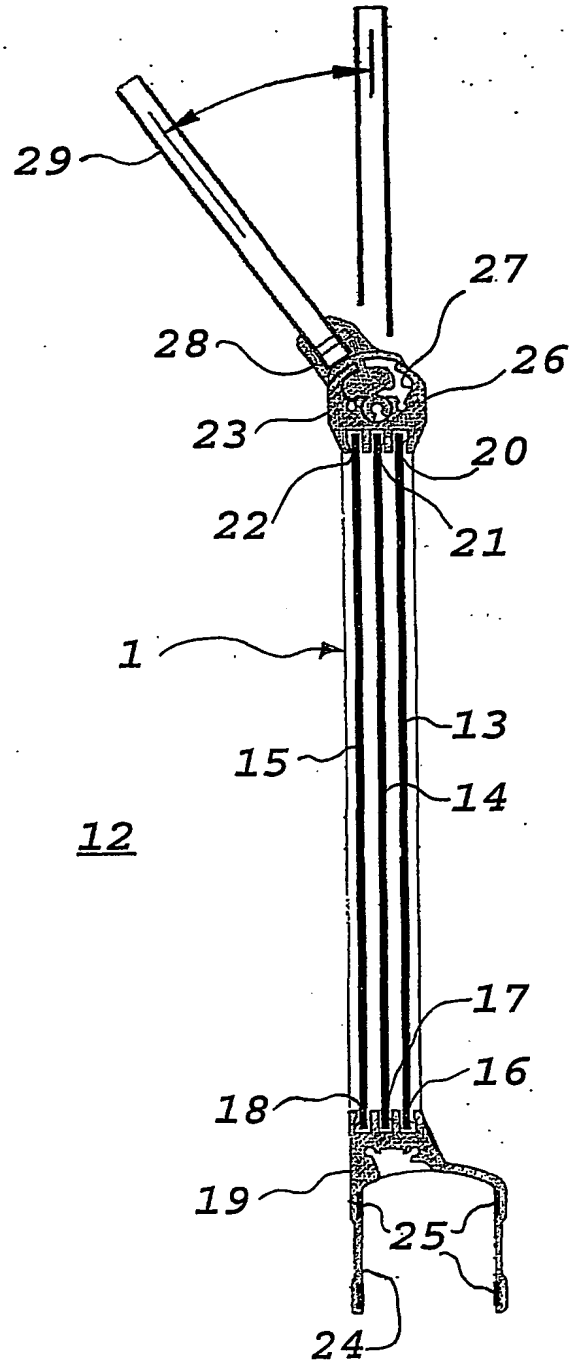


Fig 2

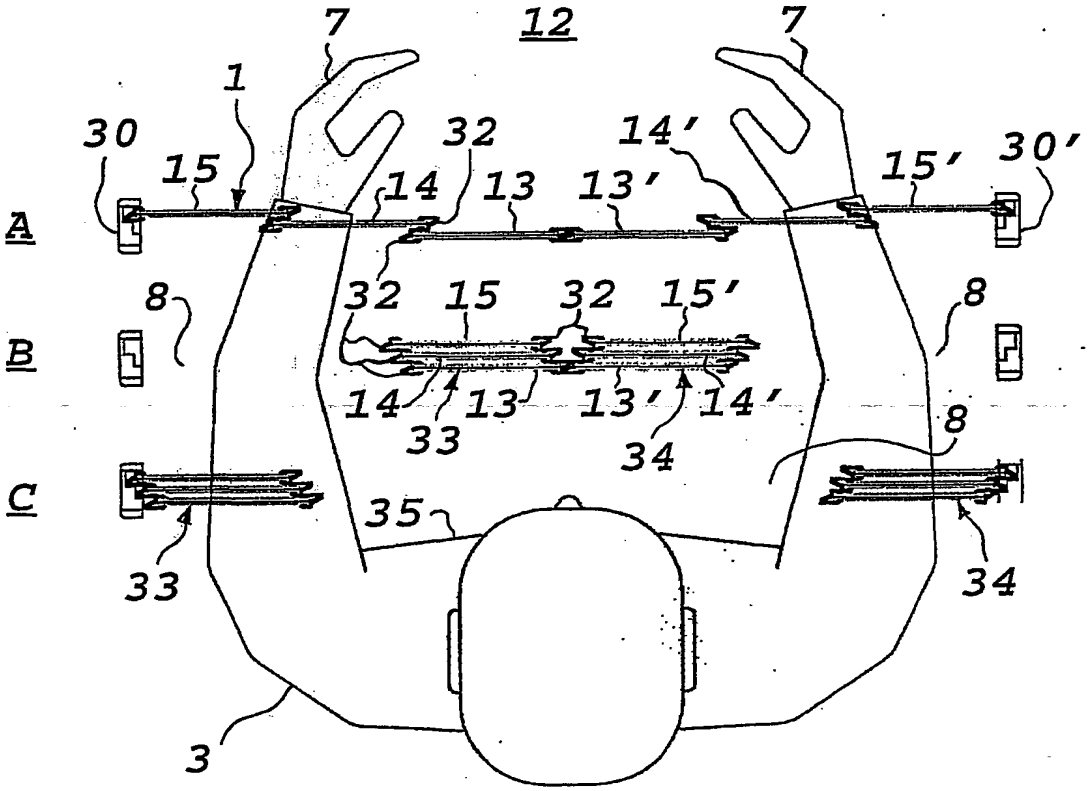


Fig 3

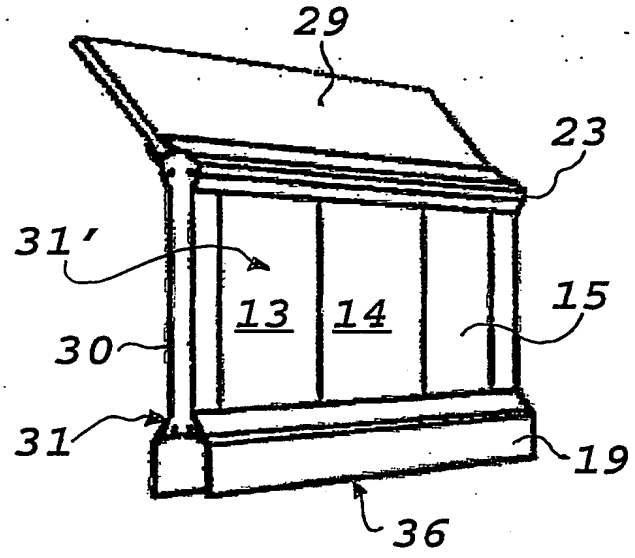


Fig 4

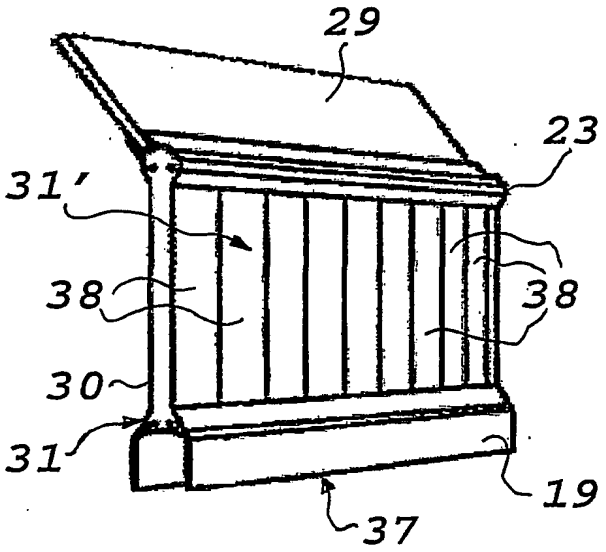


Fig 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 01/00935

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: G21F 3/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: G21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3984696 A (C. COLLICA ET AL), 5 October 1976 (05.10.76) --	1-11
A	US 4062518 A (P.M. STIVENDER ET AL), 13 December 1977 (13.12.77) --	1-11
A	US 4280056 A (G.K. RENSHAW), 21 July 1981 (21.07.81) --	1-11
A	US 4965456 A (G. HUETTENRAUCH ET AL), 23 October 1990 (23.10.90) --	1-11

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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Date of the actual completion of the international search	Date of mailing of the international search report
1 August 2001	02 -08- 2001
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Åke Olofsson / MRo Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 01/00935

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 3326880 A1 (KORTH, K.), 7 February 1985 (07.02.85) --	1-11

Form PCT/ISA/210 (continuation of second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT
Information on patent family members

02/07/01

International application No.
PCT/SE 01/00935

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US 4280056 A	21/07/81	NONE	
US 4965456 A	23/10/90	DE 8807462 U	05/10/89
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